**CONFERENCE OF THE EIGHTEEN-NATION COMMITTEE ON DISARMAMENT**

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UNITED KINGDOM

## Further Notes on United Kingdom Research of Techniques for Distinguishing Between Earthquakes and Underground Explosions

1. In September 1965, research by United Kingdom scientists on techniques for distinguishing between earthquakes and underground explosions was described to the E.N.D.C. (ENDC/155). This early work had led in 1962 to the concept of monitoring by means of some 20 to 25 control stations external to the country conducting tests: this number compared with 180 stations proposed by the Geneva Conference of Experts*. The system considered depended on the use of large arrays deployed on carefully chosen low noise sites, recording on magnetic tape, and electrical and machine processing to further enhance the clarity of the signals. The conclusion reached in ENDC/155 was that, in spite of the technical advances which had been made, there would remain a number of detected seismic events greater than magnitude 4.0 which would not be identified by remote seismic means alone and which could be suspected as possible violations of a test ban, unless they could be eliminated by some supplementary means such as on-site inspection.

2. In December of the same year (1965) the United Kingdom Atomic Energy Authority (U.K.A.E.A.) published a Special Report which reviewed the discussions and outstanding problems of Technical Working Group 2 (which had been set up in Geneva to re-examine the facts relating to underground explosions), the early U.K. work on discrimination assuming the use of a network of the type envisaged by the Geneva Conference of Experts, and the results of investigations (briefly described in ENDC/155) into the possibilities of using control stations spaced at much greater distances than was envisaged by the Geneva experts. The studies described confirmed the hypothesis that seismic signals recorded at distances between 3,000 km - 10,000 km from the source of explosion and earthquakes were much less disturbed by signals trapped in the complex transmission paths formed by the crustal skin of the earth than those recorded nearer the source; information about the source could therefore be extracted with greater clarity and interpreted with greater confidence.

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* (U.N. Publication A/3897, August 28 1958)

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3. In particular, the U.K.A.E.A. reported comparisons between earthquakes and 35 underground explosions fired at 8 different locations in the U.S.S.R., U.S.A. and North Africa. It was shown that the first group of seismic signals which arrive at a distant station (the P-wave train) could be used to identify 90% of the annual total of earthquakes down to magnitude 4.0 and to distinguish them from explosions in those regions, using three criteria. These were first motion, depth of focus and complexity, the last being the most useful. However, shortly before the report was published, another test was carried out at a new underground site. This explosion radiated signals typical of explosions to Europe, but signals typical of earthquakes to North America. Doubt was thereby cast on the usefulness of the complexity criterion. U.K. scientists are still investigating this unusual effect, and have narrowed the possible causes to the source region, and almost certainly to the effect of rugged topography on the siesmic signals spreading round the source. It is analogous to the effect of rugged topography around a receiving station, which results in signal-generated noise.

4. It is to be noted especially that the U.K.A.E.A. special report referred only to identifying earthquakes since at the time of its publication there was no established method for identifying explosions. Events were classified either as earthquakes or as unidentified events. The U.K.A.E.A. report did however refer to some observations which appeared to confirm some theoretical studies (presented by U.K. scientists at an international conference in Beaugency, France in October 1964) which predicted that explosions were much less efficient than earthquakes at generating Rayleigh surface waves (R-waves).

5. This observation offered some hope that a good criterion for identifying explosions might be developed but was not given prominence because R-waves were not well recorded by the long period equipment deployed at that time, and because it was still uncertain whether a useful detection threshold for R-waves from explosions could be achieved. Since then, however, many more observations have accumulated, which bear out the suggested relationship. In all but a very few cases the magnitude of an explosion as measured by R-waves is approximately one unit (a factor of 10) less than its magnitude as measured by P-waves. For earthquakes the magnitude determined from the observation of these two waves are the same.

6. Techniques and instrumentation for observing R-waves have been enormously improved in recent years and this method of distinguishing between earthquakes and explosions is now well established. It is the only one which enables explosions to be identified as such.

7. In 1966, U.K. scientists used the World Wide Standard Seismological Network (WWSSN) and the 4 U.K. arrays to test the surface wave, and the other three criteria, on events which occurred in that year in the Sino-Soviet region of Asia. It was also a useful test of the capability of the 120-station network, which was established on the initiative of the Vela Uniform Programme of the United States of America. These stations have a world wide distribution except for the Sino-Soviet region and transmit the arrival times of seismic signals to the United States Coast and Geodetic Survey (U.S.C.G.S.) data centre in Washington which calculates epicentre locations. The data centre also provides low cost microfilm copies of the original records. (These records were delayed up to two months, depending on the timing of routine despatches by individual stations to the data centre). With the exception of the 4 arrays the stations were all equipped with standard six component seismometers recording on photographic paper. Only the short period and long period vertical components were used in the investigations.

8. A total of 245 events were detected in the region studied, and the threshold at which 90% of the events were detected lay between $m_b$ 4.5 and $m_b$ 4.75 (where $m_b$ is the magnitude of the event as determined from the P-wave train). Surface waves were recorded from 214 of the 245 events. In 9 of these 214 results $m_b$ was greater than $m_s$ by an order of magnitude and they were located at a known test site. ($m_s$ is the magnitude of the event determined from the R-wave component). They could therefore be confidently identified as explosions. All but 10 of the remaining 31 events were identified as earthquakes, using the other three criteria. 10 events remain unidentified, and the magnitude of 8 of them lie below the threshold for 95% confidence in detection. Of the other two one appeared to have been located at a known test site and may therefore have been an explosion.

9. In this study the detection threshold of the W.W.S.S.N. for earthquake R-waves was similar to that for P-waves, as would be expected. On the other hand, for explosions, the detection threshold for R-waves corresponded to an event which gave $m_b$ equal to 5.25.

10. These results were presented to the study group on seismic methods for monitoring underground explosions organized by the International Peace Research Institute, Stockholm (SIPRI). They were the principal data on which the group concluded that the national systems which are operational at the present time could detect and identify explosions in the Northern Hemisphere down to a level of 20 - 60 kilotons. On the basis of research presented by Canada, the U.S.A. and the U.K., the group further concluded that the R-wave criterion was valid down to $m_b$ 4.5. This was tacitly accepted by the group to be the equivalent of about 10 kt. There is not however complete technical agreement about the exact hard rock magnitude-yield equivalence and the discussions are without doubt confused by differences in regional geology.

11. The study group also concluded that it is possible to reduce by a factor of 10 the amplitude of the P-signal by conducting explosions in a suitable thickness of dry alluvium. It was agreed that dry alluvium is present in most continents in thicknesses sufficient to decouple up to 20 kt, that is to reduce an event in hard rock of $m_b$ 5 to one of $m_b$ 4. Since $m_b$ 4 is close to the ultimate detection threshold of a practical control system, it is difficult to see how it will be possible to achieve a high probability of seismically locating a 10 kt explosion which is fired in dry alluvium at distances greater than two or three thousand km, let alone to identify it by means of its R-waves.

12. The SIPRI study group therefore made two significant advances in terms of scientific agreement: it agreed that explosions of yields down to 10 kt in hard rock could be identified (given the deployment of a seismic system incorporating the improvements suggested in the SIPRI report) and it agreed that seismic amplitudes from explosions of up to 20 kt could be reduced by a factor of ten by firing in dry alluvium. The United Kingdom conclude that seismological verification of a test ban over large areas is limited to yields of about 10 kt and over: and even this capability assumes that modern equipment replaces that of the standard stations. Improving the instrumentation of the existing network may, however, be uneconomical or insufficient to do more than fully realize the limited capabilities recognized by the SIPRI group: to lower the identification threshold (and there are already some studies which indicate that this can be achieved) it may be necessary to consider new systems. Stations using new techniques are listed in table 1.1 of the SIPRI report and their capabilities habe been described in a large number of reports. The next step may be a detailed study of the ways and means of deploying an operational system based on the new techniques.

ANNEX

ANNEXE

ПРИЛОЖЕНИЕ

ANEXO

# PUBLICATIONS ON DETECTION GEOPHYSICS BY SCIENTISTS OF THE UK ATOMIC ENERGY AUTHORITY AND OTHERS

# PUBLICATIONS TRAITANT DE LA GEOPHYSIQUE DE DETECTION DUES AUX SAVANTS DE LA UNITED KINGDOM ATOMIC ENERGY AUTHORITY OU D'AUTRES

# ПУБЛИКАЦИИ УЧЕНЫХ УПРАВЛЕНИЯ ПО АТОМНОЙ ЭНЕРГИИ СОЕДИНЕННОГО КОРОЛЕВСТВА И ДРУГИХ СТРАН ПО ГЕОФИЗИКЕ ОБНАРУЖЕНИЯ

# PUBLICACIONES SOBRE GEOFISICA APLICADA A LA DETECCION, DE LAS QUE SON AUTORES CIENTIFICOS DE LA U.K. ATOMIC ENERGY AUTHORITY Y OTROS HOMBRES DE CIENCIA

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A. Articles de synthèse

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CANADA

Remarks by G. Ignatieff, Representative of Canada at Informal Meeting on CTB, Wednesday, 13 August 1969

INTRODUCTION

In leading off today's informal meeting on the subject of a Comprehensive Test Ban, I should perhaps begin by outlining the reasons for the Canadian decision to call for this session. Delegates will remember that on 23 May I submitted to the Committee a Working Paper on seismic exchanges (ENDC/251). At that time, I pointed out that General Assembly resolution 2455 (XXIII) requested this Committee to take up "as a matter of urgency" the elaboration of a treaty banning underground nuclear weapon tests; no wonder, since, as everyone knows, there is nothing more symptomatic of the continuation of the nuclear arms race than the continuation of testing of nuclear weapons. As the time is fast approaching when the Committee must prepare its usual report to the UNGA making an accounting of just what has been accomplished at this 1969 session in response to the Assembly's resolution, the Canadian delegation is of the opinion that steps must be taken which would permit the report to demonstrate some progress in this critical area. Our Working Paper outlined what we considered would represent a minimal degree of progress--agreement to issue a call for essential data on seismic exchanges which would be a prerequisite for any more effective exchange mechanism.

We recognize that we are not alone in our desire to effect progress in this field. The delegations of Sweden, the United Kingdom, Ethiopia and Japan have all, during the current or previous session of the Committee, advanced various ideas regarding more effective exchanges of information. We consider that the proposals put forward in our Working Paper might therefore receive the support of other interested delegations, and it is our hope that by convening this informal session, we may help pave the way to define some common purposes in this important area.

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It is the belief of the Canadian delegation that, before specific machinery can be considered for any worldwide seismological data exchange, clarification is required on the extent of co-operation which governments would be prepared to extend and the form in which seismic information might be made available.

Our Working Paper addressed itself to this specific aspect of the seismological exchange proposal on the assumption that the problems of verifying any Comprehensive Test Ban would decrease provided an exchange of original seismological data could be assured. We recognize, however, that there is a definite relationship between any Comprehensive Test Ban and progress in the USA/USSR bilateral negotiations on the limitation of strategic weapon vehicles.

As I said in my remarks at the 424th meeting of this Committee on 31 July, if we are to make progress "in the first instance we have to seek common purposes on each issue before trying to agree on language". It is our hope in this informal meeting that with the help of the experts present, through the process of questions and answers we will find certain aims in common which will be useful both from a scientific as well as from an arms control standpoint (and perhaps it is well to bear in mind that the less inexact the questions, the less inexact the answers are likely to be.)

I would hope that in our discussions today we might clarify the technical aspects of the role of seismological exchanges in any verification proposals, keeping in mind that progress in the political field is, of course, basic to the eventual negotiation of a complete test ban. We are, moreover, hopeful that this meeting will help to crystallize the informal expressions of interest--and for that matter, support--which have so far come to our attention. I cannot conceal from you, and I think we are probably on common ground here, that my main concern is to try to ensure that some progress may be reflected in our UNGA report. I hope, therefore, that the results of this morning's discussions will give us all some guidance on the most useful course to pursue with this consideration in mind.

In order to assist the Committee in understanding fully the Canadian proposal outlined in our Working Paper, we have arranged for a senior Canadian seismologist, Dr. Kenneth Whitham, to be present for these informal discussions. With your permission, therefore, I propose now to ask Dr. Whitham to offer some explanation of the technical aspects of the Canadian proposal. I would further suggest that, after an opportunity has been provided for the observations of any other delegations, Dr. Whitham would be willing to answer questions on this subject, insofar as specific answers can be provided at this stage in the development of Canadian capabilities in this field

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Remarks by Dr. K. Whitham at the Informal Meeting on CTB
13 August 1969

It appears self-evident that the effectiveness of seismological verification of a comprehensive test ban is a major issue before this Committee. The discussions here indicate that there is, as yet, no agreement between the different powers about the national security risks involved for them in the event of their acceptance of any one of the different proposals introduced from time to time in this Committee. The only clear agreement apparent at this time is that improvements in seismological verification must help to hasten an acceptable test ban, and that, as the SIPRI Report indicates, remarkable improvements in seismological verification have been developed by the seismologists of the world in the last decade.

As the Canadian representative stated at the 404th Plenary Meeting of the ENDC on 17 April 1969, in seismology there has been a long tradition of informal international co-operation in the study of earthquakes, between scientists and institutions in many different countries, both bilaterally and multilaterally through existing international and regional seismic centres. This exchange has covered abstracted information from seismic records, the seismic records themselves and the results of scientific analysis, and in general these exchanges on earthquakes for humanitarian and scientific purposes have been restricted by economic rather than political factors. This international co-operation is to everyone's mutual benefit since the seismological waves from earthquakes travel through the earth without respect for national frontiers.

I would like to remind this Committee that the seismic waves generated by underground nuclear explosions also do not recognize national frontiers.

We believe that the problems in seismological verification of a test ban, whether complete or of a threshold nature, would decrease if guaranteed access to all original seismological data could be assured. The reason is simply that it is necessary both to detect and identify underground nuclear explosions against the background of natural earthquakes, and both the detection and identification problems are simplified with widespread data including data at regional distances from the shot point. By simplification, I mean that the seismological detection and identification can be made increasingly effective for lower and lower yield explosions, as increasing and more nearby data is made available. In particular, the method of identification which depends upon the partition of the energy between long and short periods being different for an underground explosion and for a natural earthquake can only be applied if the principle works for the yields of interest and if the detection capability for the long and short period waves exists to apply the identification criteria. The guaranteed availability of seismic data will enhance research on the validity of the method at lower yields, about which there is as yet no universal technical agreement for explosions with body wave magnitude below perhaps 4 1/2 to 4 3/4. It will also immediately increase the area of the earth adequately covered by this technique at any calculable magnitude such as, for example, explosions with a body wave magnitude 5. It should then be possible for technical advisers to estimate the effectiveness of verification for any and all regions, which effectiveness must depend upon what data governments will make available.

I should like to give an example. For underground nuclear explosions at the Nevada Test Site, using data from the Canadian standard network, we have published results which we believe unequivocally demonstrate that for this combination of test site and observing stations, the identification method mentioned above works down to explosions with an equivalent body wave magnitude 4.5, that is to say for explosions of about 5 to 10 kiloton yield in hard rock. Unfortunately, and this is most important, by this magnitude we are at the limit of capability of detection of the long period signals with our standard seismic network and therefore although we believe we have

proved that the method works and might indeed work at even lower magnitudes, we know that we have a rapidly falling possibility of detecting the long period signals and that at some magnitude range, which is above the 4.5 lower limit I have quoted above, our probability of being able to apply the method is not high. Now, if we apply the same technique to some presumed underground nuclear explosions in Central Asia, we find for this new combination that we have no detection capability for the long period waves using the Canadian network below explosions with a body wave magnitude of about 5.9, i.e., about 200 kiloton yield in hard rock. The difference is essentially, we believe, produced by the increasing distance between the stations and the shot point, the fact that for the second example given above the long period waves cross two ocean-continent boundaries, and that certain other natural peculiarities involving the structure of the outer layers of the earth favour the first combination. We know, and work published in the SIPRI Report confirms this, that seismic data is obtained at the present time at closer distances to the Asian test site than Canada and the amount of data already freely available allows a considerable reduction in the body wave magnitude 5.9 figure quoted above for the Canadian network alone looking at this site. The exact amount of the reduction depends upon the location and instrumentation at the seismic stations and the usefulness of the criterion in verification for this site depends upon which data would be guaranteed available. These sorts of arguments with different but calculable numbers could be applied in reverse by, for example, an Asian country in seeking to monitor the Nevada Test Site.

Before finding acceptable economic and technical means to ensure the worldwide availability of seismic data, it seems to us that the first step is to clarify what seismic information governments would make available, in what form and with what delays. We believe that the answers to these questions are directly relevant to the possibilities of coming to an agreement about a test ban which is the direct concern of this Committee. We further believe that such a clarification will increase the possibility of smaller countries being able to make their own technical assessment of some of the different problems involved and enable some of them to contribute usefully, through this forum and elsewhere, to this vital debate.

We do not hold fixed views about the mechanism of such a data exchange. We are aware that, at one extreme, a world depositary of data could be envisaged perhaps, but not necessarily, as an extension of one of the already existing international centres for seismology. In this respect we are also aware that the international seismological community and UNESCO are discussing at present the needs, problems and economics of one such centre at Edinburgh. We believe that no centre is equipped at the present time to act effectively as a worldwide seismic data archive, but one could conceivably so become if this were the wish of the international community. We are also not forgetting that a major international archival service would produce considerable advantages for the science of seismology in general.

At the other extreme we can envisage the situation where access to guaranteed data is required by only a few countries for a limited number of stations for a limited number of events only and both these may vary according to the particular national requirement. We consider that at this extreme of demand, it is unlikely that a seismological centre for this purpose need be established or developed.

With respect to the delays inherent in the supply of copies of the original data or the original data themselves, we would express the hope that these could be minimized. It is my personal opinion that a matter of some weeks would be the order of time interval which any country or international body, if one were so created, would require to assess the situation created if a concealed test were suspected or claimed, and if verification in a treaty situation depended on a seismological decision. This interval of time appears to us to be entirely compatible with the time framework within which the seismic networks could distribute copies of data without excessive expense and effort on their part. In making our proposal, we invite the views of the member states and in particular those of countries which operate the larger seismic networks. The guaranteed availability of seismic data without archival deposition would merely formalize existing international practice for earthquakes without further extensive costs to co-operating countries. However, our proposal would extend existing practice to cover explosions and events which any nation considered suspicious and would give governmental assurances of the availability of the data on request from those stations listed.

The technical data listed in the Canadian proposal is not in any way different from that which would normally be supplied by any scientist or institution to another with record copies for purposes of earthquake research.

We regard this modest proposal as a first and logical step in any process whereby the seismologists of the world can help the essentially political decision-making processes and provide the best guide for them.

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JAPAN

Statement by Ambassador K. Asakai at the informal meeting of ENDC on 13 August 1969

1. At the 424th meeting of July 31, I put forward a suggestion concerning the system of verification which would monitor underground nuclear explosions. My suggestion consisted of four specific measures. First, to expand and improve the network of seismological observatories; second, to promote the international exchange of seismic data; third, to establish an international centre which will process all these data promptly; and finally, to establish an international monitoring centre which shall objectively analyse these data.

The Canadian suggestion concerning the registration of seismographic stations contained in its working paper (ENDC/251) is, we believe, the first step toward the expansion and improvement of the network of seismological observatories and the promotion of international exchange of seismic data which I have just mentioned.

It is for this reason and in this sense that the Japanese Delegation supports the purport of the Canadian working paper.

2. However, I have some comments to make on this working paper.

The Canadian working paper states "the ENDC requests the governments concerned to supply to the Secretary-General of the United Nations for transmission to the ENDC, a list of all its seismic stations from which it would be prepared to supply (relevant) records."

If we adopt such a procedure, information concerning the instrumentation and components recorded which is to be supplied by the governments concerned in accordance with the Canadian formula could well become divergent in ways of its description.

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In order to obtain the unified answer it might be advisable that the lists of seismographic stations which have already been prepared by such international or major national centres as those in Edinburgh, Strasbourg, Moscow, Washington and Tokyo, should be compiled into a list with appropriate format, which then shall be sent to the Governments concerned, requesting them to correct and complement it.

Particular attention must be paid to the station list prepared by the United States Coast and Geodetic Survey which covers almost all seismological observatories in the world, although that list does not contain description of the instruments employed in the observatories. I must also refer to "Parameters etc. of the Main Seismic Stations of USSR" prepared by the Institute of Physics of the Earth, Academy of Sciences of USSR, which well describes the characteristics of the instruments employed in the main Soviet Stations.

3. With regard to the data to be exchanged, the Canadian proposal seems to cover seismogram copies only. But, as I explained in my statement on July 31, my Delegation attaches an equal importance to the interpretation message to be sent to one international centre by cable every day. It seems to be advisable to register all observatories which can provide a daily interpretation message and/or seismogram copies.

It may be added, that if all seismogram data are to be exchanged, they will be too voluminous to be properly dealt with. In our view, therefore, it may be more practical to obtain necessary data on a request basis, as I suggested on July 31.

4. Now, Mr. Chairman, I must beg your indulgence for making some detailed and technical comments on the Canadian working paper. I do this as the paper under reference itself deals with technical points.

First, it might be better to replace the word "Photographic" of (a) of Page two of the working paper by "graphic", because recordings are made in the form of ink-writing or heated-stylus as well. May I also suggest that the name of the operating organization, the address and the date of the beginning of observation should be added after the name of station of (a) (i) and (b) (i) of Page two?

I would also like to suggest the addition of the words "height above the sea level, geological and geomorphological description of the station foundation" after the words "coordinates of station" which are found in (a) (ii) and (b) (ii) of Page two.

The Canadian working paper also states in the middle of page two that "original records or good quality microfilm, and if the latter, whether the microfilm would be 16.35 of 70 millimetre film", but it seems to us that this part is too strict and detailed. My delegation prefers that this part be replaced by "original records or some appropriate copies".

5. I hope that the Canadian Delegation will give due regard to the suggestions made in this informal meeting and submit to the ENDC its revised working paper for final adoption by the United Nations General Assembly at its coming session.

**CONFERENCE OF THE EIGHTEEN-NATION COMMITTEE ON DISARMAMENT**

ENDC/261
14 August 1969
Original: ENGLISH

INDIA

Statement by Ambassador M.A. Husain at the Informal Meeting of the ENDC held on 13 August 1969 to consider the question of a Comprehensive Nuclear Test Ban

1. The delegation of India is strongly in favour of intensive co-operation for international exchange of seismological data, which would facilitate a comprehensive nuclear weapon test ban. The Indian delegation, therefore, welcomes the initiative taken by the delegation of Canada in submitting its working paper (ENDC/251), in which it has proposed that "countries be invited to send a list of the seismograph stations from which they would be ready to supply records on the basis of guaranteed availability of data in the framework of a world exchange of seismic data and provide certain details concerning these stations". The Canadian delegation has also suggested that a request be made by the ENDC to Governments on these lines.

2. I should like today to offer the views of my delegation on certain aspects of the Canadian proposal.

3. Undoubtedly, an effective scheme for the unrestricted exchange of high quality seismic data on a world-wide basis, coupled with centralized means for collating and reducing them for quick and reliable interpretation leading to accurate estimates of location, depth and nature of seismic sources will help to remove to a very great extent, if not fully, the remaining reservations, as to the effectiveness of seismic means for verifying a comprehensive test ban treaty. As was brought out at the SIPRI meetings last year such a step would only be an extension of the principle of international co-operation which has been the main feature of seismological research and development.

4. However, the data exchange required for improving seismic methods of detection and identification, would clearly need to be more elaborate and diversified. It should include (a) the complete, original record of all the phases of the seismogram covering the entire spectrum of earth waves, (b) the exact response characteristics of the sensing and recording instruments, (c) the precise location and configuration of the instruments or the network of instruments deployed for detection, (d) a complete description of the format in which the data is available and (e) an indication of the accuracy of the time information.

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5. A clear idea of the characteristics of instrumentation and recording formats is indispensable for evaluating the requirements of the centralized processing facilities needed to utilize fully the extensive data involved.

6. Equally useful from the point of view of enhancing the reliability of seismic identification of underground explosions would be the following data pertaining to underground tests:

(a) The scheduled time of firing.
(b) Latitude and longitude of test point.
(c) Depth at which the device is emplaced.
(d) Yield.
(e) General topography and geology of the test area.

7. The Canadian proposal is quite in conformity with the stand consistently taken by us, in relation to exchange of seismological data for which our data is freely available. However, the financial implications, and logistic support required for commiting ourselves to such an arrangement will have to be examined carefully.

8. From a purely technical point of view the information sought in document ENDC/251 may be augmented as follows:

(a) (i) Option of Zerox copy of the original records.
(ii) The tine resolution in, say, millimeters per second of each type of record.
(iii) The estimate of precision of the tining system.
(b) (iv) The lay-out drawing of the array, the depth of emplacement of sensors, and topographical and geological features of the array site.
(v) Indication of the type of raw magnetic records whether digital or continuous, as well as the normal period up to which they are retained; the format in which library tapes containing events of a specified type or above a specified magnitude are prepared for long-term preservation.
(vi) Accuracy of the time code.

9. The Department of Atomic Energy of the Government of India operates stations of "b" type only in the form of a medium aperture short period array and some long period instruments in Southern India. With the existing processing facilities, we will not be able to release the original tapes earlier than six months after recording. By this time, they would hardly be useful for the international processing scheme envisaged.

The most convenient method, therefore, for making copies available for exchange would be to take duplicate recordings of both short and long period instruments of our array.

10. In conclusion, Mr. Chairman, I would like to reiterate that the Government of India would have no objection to providing the information required in respect of our Southern Indian station. However, as mentioned earlier, this process would have financial implications, since it would be difficult for us to loan the original magnetic tape containing the information. I should think that a similar problem would be faced by many other countries as well. Should it, therefore, be decided that the ENDC should address a letter to Governments on the lines suggested by the Canadian delegation, an enquiry may also be made whether their countries envisaged any financial implications in meeting the request for information.

11. The Government of India would thus be ready to co-operate actively in any system of seismological data exchange provided it is an effective one based on the equal participation and full co-operation of all concerned.

**CONFERENCE OF THE EIGHTEEN-NATION COMMITTEE ON DISARMAMENT**

ENDC/262
14 August 1969
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UNITED STATES OF AMERICA

Remarks by Ambassador James Leonard on Seismic Data Exchange and the Canadian Working Paper (ENDC/251) at Informal Meeting on 13 August 1969

I would like to comment first on the general subject of seismic data exchange and then to make some specific suggestions regarding the Canadian proposal.

As many of you will recall from the last meeting of our spring session, Ambassador Fisher, speaking for our delegation, said that we believe seismic data exchange would serve as a useful complement to a comprehensive test ban, which in our view would have to include on-site inspections for adequate verification. On the basis of our belief in the value of seismic data exchange, we have been making efforts, both on our own and with others, to bring about greater cooperation in this field.

For example, considerable progress in seismology has resulted from research which the United States Government and private United States institutions have performed and published, and from seismic data made available through the operation of the US-sponsored World-Wide Standard Seismograph Network (WWSN). This network now has 115 seismic stations, including stations in several states represented in this committee. In addition, the Montana Large Aperture Seismic Array continues to be operated as a research tool to provide data for evaluation of the detection capability of such arrays. We are, in cooperation with Norway, installing a second large array -- the Norwegian Seismic Array, called NORSAR -- which we hope will be completed this fall. Finally, we are pleased to announce that we are going forward with Project Rulison, an underground nuclear explosion for peaceful purposes aimed at developing the technology for increasing the production of natural gas. The project is now tentatively scheduled for September 4, 1969. As we explained in our working paper on seismic investigation (ENDC 252), this experiment will help in our efforts to

facilitate world-wide evaluation and comparison, to the extent that the data are exchanged, of the seismic information gathered on such events.

In line with this demonstrated interest in seismic research, the United States stands ready to make available a list of seismic stations from which we would be willing to supply records in a world-wide exchange of data, as suggested by our Canadian colleagues. We are also willing to supply all the pertinent data on technical characteristics of these stations.

In view of our own readiness to cooperate in data exchange along the lines suggested by Canada, we, of course, hope that other countries whose participation would increase the value of the exchange will also join in. Carrying out the Canadian idea would be a useful step in implementing UN General Assembly Resolution 2455, and would be welcomed as a sign of progress on a question to which the General Assembly has attached great urgency.

Our technical experts have carefully studied the information requirements for a possible questionnaire, and their conception of what would be most useful has been passed out to each delegation (see attached suggested revision). With your forebearance, I would like to go through the revisions and explain the reasons we are putting forward these suggestions for consideration.

First, you will note that we have suggested two different categories of stations about which information would be provided. Category (a) would now cover conventional seismograph stations and (b) would cover array stations. This seems to us a more useful distinction than that now made by the Canadian proposal between photographic and tape recording types of stations. Since there are other common types of seismograph recordings, such as smoked paper and hot wire, the categories we suggest would insure that governments would know how to respond for any type of seismograph.

Second, under sections (a) (iii) and (b) (iii), dealing with the instrumentation and components recorded, we believe that a response curve for each instrument should also be provided. Our technical advisors believe that information on response curves is very desirable for any significant data exchange because of the need to provide a basis for accommodating differences among the various instruments in use.

Third, under the category (b) we propose, we have added two more requests, (iv) and (vi), which involve, respectively, coordinates of array points and a list of components which record on a parallel visual basis. This information would also be helpful to participants in deriving maximum possible utility from the data exchanged.

Finally, if our suggestions are incorporated it would be possible to delete the requests under (a) and (b) of the Canadian paper which call for full operational curves to be provided, since this information would already be covered. In our suggested revision we have consolidated in the last paragraph the statements regarding the time window within which governments would provide records, and the availability of original magnetic tape recordings.

In conclusion, Mr. Chairman, I would like to express my delegation's hope that the Canadian proposal will help us to make badly needed progress in the near future. For our part, we are very appreciative that the Canadian delegation has presented its suggestions to this committee. We think these suggestions are practical and valuable.

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Suggested Revision of Requests for Technical Information

(a) Conventional seismograph stations

(i) Name of station

(ii) Co-ordinates of station

(iii) Instrumentation and components recorded. (This should include operational magnification at one second periods for short period and broad band seismographs and at 15 or 20 seconds for long period instruments. Also, a response curve for each instrument should be provided.)

(b) Array stations

(i) Name of station

(ii) Co-ordinates of station

(iii) Instrumentation and components recorded. (This should include operational magnification at one second periods for short period and broad band seismographs and at 15 or 20 seconds for long period instruments. Also, a response curve for each instrument should be provided.)

(iv) Coordinates of array points

(v) A general account of the instrumentation geometry of the array.

(vi) A list of components which record on a parallel visual basis.

It would also be useful to know the time window within which the Government of ... would be prepared to supply the original records or, as applicable, photographic copy, magnetic tape copy, or good quality microfilm (16, 35, or 70 mm). It would also be useful if the Government of ... could indicate how long an original magnetic tape recording could be made available before the tapes were erased and re-used.

**CONFERENCE OF THE EIGHTEEN-NATION COMMITTEE ON DISARMAMENT**

ENDC/263
20 August 1969
Original: ENGLISH

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ITALY

Statement by Ambassador R. Caracciolo at the Informal Meeting of the ENDC on 20 August 1969

First of all I should like to express my gratitude to the co-Chairmen for having accepted to convene this meeting for a preliminary discussion regarding the Committee's report to the XXIV session of the General Assembly and to thank all Delegations for graciously accepting this extra burden on their daily work. I should also like to avail myself of this opportunity to extend my warmest welcome to the Delegations that have joined our Committee more recently. This welcome applies, of course, to all the six new Delegations equally, with whose Governments, my own has the most friendly relations. May I add, however, in view of the very close collaboration existing between our respective Country in different fields, that we are particularly happy to see among us the Delegation of the Netherlands.

I will now try to explain to the Committee the reasons that have promoted me to address the request for this meeting on behalf of my Delegation.

The main reason stems from the feeling that our discussions have reached a crucial stage. Though we are confronted with more draft treaties than we have discussed before, on each of them the views of the nuclear delegations are still wide apart and we see at present few prospects for reaching any agreement before the end of this session. Therefore, despite the valuable efforts made during the present session and the concrete contributions of all delegations, the ultimate goal of our negotiations - which is actual disarmament, especially in the nuclear field - is still far from sight. Even if some progress were to be made in these last few weeks in one more specific field (and Italy would be among the firsts to welcome such development), it would very likely be progress towards an agreement on a non-armament measure rather than progress toward strictly disarmament measures.

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On the other hand, we are confronted with resolutions from the General Assembly and with the Agenda formulated by our very Committee, both of which clearly indicate the direction our work should take. In other words, there seem to be a certain gap between the work we are supposed to do and the one we are actually doing.

We are also approaching the moment when the valuable and important work we have done in 1969 will come under the scrutiny of the General Assembly. That body will have no other way to judge it, than by going through the final report submitted, as in previous years, by our Committee. I am afraid that a report of a factual character, that is a report mentioning only, in less or greater detail, the topics discussed, the meetings that have taken place, and the documents that have been submitted, would lend substance to the criticisms we have heard in the past, which imply that the structure of our Committee is not the most suitable one in order to fulfill the task that has been given to us. The very existence and the very survival of our Committee might then be jeopardized. We therefore believe, and we hope that this belief is shared by other delegations, that this year's report to UNGA should have a substantial character.

Another valid reason why the report to the XXIV Assembly should be this year, of a more positive character is the fact that our Committee has undergone a substantial enlargement with the addition of eight new members; this is a milestone in the history of the ENDC and, in our opinion, it should be marked by a renewed effort by the Committee to prove that real efforts are being made to come close to the expectation of mankind which still looks upon this body as a concrete hope for making progress along the hard but essential road to disarmament.

The important point is, therefore, to agree on what is meant by a substantial report.

As I said, before, I do not think that even a lengthy list of topics, of meetings, and of papers, would be sufficient to qualify our report as a substantial one, or that it would give the General Assembly that ray of hope it is entitled to, and is looking forward to. No doubt it will show that we have been very hard at work and that we have made great efforts during this year's session, but I am afraid that just would not be enough to inspire confidence on the results we may attain in the future. A substantial report would, in our mind, be achieved if besides sinthesizing the core of our discussions and the difficulties we have met, we were to devote a certain part of it,

to some hard thinking on the shape and nature of our future activities. By doing so we would at least convey to the General Assembly our earnest conviction that though we have not been able so far, because of objective difficulties, to make substantial progress in the fields assigned to us, progress could be reasonably expected, in a not too distant future, through an improvement in our methods of work, coupled with a renewed determination on the part of our Governments.

The Italian Delegation has, for a long time, upheld the necessity of an organic programme of disarmement. By organic programme we meant something different and more precise than the provisional Agenda we agreed upon on 15 August 1968 exactly one year ago: the Agenda was, in part, mainly a list of headings for the members of the Committee to discuss. What we have in mind is a clearer definition of a programme of work, both short and long term.

Of course our intention never was to suggest a philosophical exercise or an academic discussion, nor did we ever think, that the pieces of this programme should be linked one to another with rigid ties to form a sort of a package deal.

The kind of programme we had in mind was instead a very flexible one, but one that could somehow provide the necessary guidelines for our future work and increase its efficiency. We are, in fact, fully aware of the tremendous difficulties which lie on the road to general and complete disarmament and which stem from the harsh facts of international life: mainly the necessity to maintain the balance of forces as a prerequisite to armament reductions. It is, however, undeniable that the search for an agreement on several specific sectors has made us lose, to a certain extent, the indispensable over-all view. And this is a dangerous fact since the balance of interests, which is the natural foundation of any agreement, is all the more difficult to achieve if the search for it is limited by the narrow framework of each specific measure. It was with the purpose of regaining this over-all view, of trying to bring our starting point closer to our final goal, that we tabled, at the last session, the working paper ENDC/245.

I would like to summarize the suggestions we submitted in our working paper in order to furnish a concrete example of the thoughts I am trying to express:

We first listed some of the basic premises of present ENDC negotiations; they are well known to everybody and therefore I need not dwell on them: it would be sufficient to quote the joint statement of agreed Principles for Disarmament negotiations submitted in September 1961 to the Geneva Conference by the Governments of the USA and

of USSR; the plans for general and complete disarmament submitted respectively by the Soviet and the American delegations on 15 March and on 18 April, 1962; Resolution 2454 B (XXIII) of the General Assembly; and the most significant promise of them all, that is art. VI of the N.P.T. by which the nuclear powers, as well as the other parties to the Treaty, undertook ....."to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control".

After having recalled these premises of our work, we expressed in our document the belief that the aim of ENDC negotiations, that is general and complete disarmament, could best be attained by a series of agreements to be reached in a suitable sequence - that is within the framework of an over-all programme - so as to guide the process of disarmament from the introductory stage to the final one. Though we did not deem it proper, at this stage, to anticipate detailed propositions we thought, only as a matter of suggestion - that a suitable sequence could proceed along the following lines which I will express in five points:

(1) Since a wide consensus seems to exist on the point that priority should be given to negotiations on interrelated subjects with a direct bearing on the problem of stopping the vertical proliferation of nuclear weapons by states now possessing them, we thought that within this framework, the beginning of bilateral talks between the Governments of the USA and USSR for the limitation of strategic armaments was, of course, of paramount importance.

(2) We then thought that in a preliminary stage new efforts should be made to carry on discussions in order to reach agreement on measures aimed at preventing the spread of nuclear weapons to new environments where they have never been deployed, and at limiting the zones in which they may actually be deployed.

(3) In this same preliminary stage, we also thought that other measures might be negotiated in order to promote a climate of greater confidence among Nations. Such measures could apply to specified Parties, having particularly in view the situation prevailing in Europe as one of the focal points of international tension.

(4) After significant progress had been made towards the cessation of the nuclear arms race and the creation of an atmosphere of greater confidence, a first stage of concrete negotiations on actual disarmament could then take place.

(5) Subsequent negotiations on further stages, linked to one another and following the principle of gradual and balanced reductions, might then lead to the ultimate goal of general and complete disarmament.

As I said these were the general thoughts that prompted my Delegation to introduce its working paper on 21 April. We never had the pretention that they could represent the only or a complete answer to the problems we mentioned; we only hoped that they could constitute an useful contribution to a general discussion on the subject.

Today we are confronted with a first draft report prepared by our co-Chairmen. While expressing the appreciation of my Delegation for the effort they have made in presenting us with a complete text in such a short time, and for giving us the opportunity to consider it with all the attention it deserves, I am sorry not to be in the position, as of today, to comment it in detail and to give our reactions. On the other hand, this meeting having been requested for the purpose of enabling all Delegations to participate in a preliminary discussion on the drafting of this Report, we shall certainly study, in the next few days, the text that has been submitted to us informally with the greatest attention, also in the light of the comments that other Delegations will wish to make.

I would also like to ask the Secretariat to circulate my statement of today as an official document of the Conference.

**CONFERENCE OF THE EIGHTEEN-NATION COMMITTEE ON DISARMAMENT**

ENDC/264
21 August 1969
Original: ENGLISH

BRAZIL

Working Paper on the Control Provisions for a Treaty on the Non-Armament of the Sea-Bed and Ocean Floor

The Government of Brazil follows with great interest and high expectations the current negotiations in the Conference of the Eighteen Nation Committee on Disarmament concerning a Treaty on the non-armament of the sea-bed and ocean-floor. In the present stage of development of the technology for the exploration of the sea-bed, only a very limited number of States has the capacity to carry on large-scale activities in this environment. For this reason, the Government of Brazil regards with apprehension the possible implications of a Treaty on the non-armament of the sea-bed and the ocean-floor that could damage the interests of medium and small nations still lacking those technological resources. This possibility would in any case run counter principle five of the Statement of Agreed Principles on Disarmament Negotiations, of 20 September 1961, which asserts that: "All measures of general and complete disarmament should be balanced so that at no stage of the implementation of the Treaty could any State or group of States gain military advantage and that security is ensured equally for all". The Government of Brazil considers that Coastal States have sovereign and exclusive rights to explore and exploit the resources of their continental shelves. Thus it believes that none of these sovereign rights can be jeopardized or disregarded, directly or indirectly, as a consequence of an international Treaty on Disarmament. By creating a process of control of compliance with its objectives, a Treaty which prohibits the installations of weapons or weapon systems on the sea-bed can conceivably create such risks if utmost consideration is not given to the inclusion of appropriate provisions that would prevent these undesirable consequences. The Government of Brazil considers it indispensable that the future Treaty should safeguard the continental shelf of Member States from undue interferences which could materialize if the control provisions are not clearly formulated. It is indeed necessary to prevent situations where, under the allegation that a normal

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verification of compliance is being sought, operations would actually be deployed that could threaten the security and the sovereignty of the Coastal State or to violate its exclusive rights of exploitation of the continental shelf. Since there exists a substantial technological gap among Contracting Parties of a Treaty on the non-armament of the sea-bed and ocean-floor, it is possible to foresee several instances when the Coastal State will not be aware of operations that are going on its continental shelf and/or may be lacking the means to acquire firm assurances that these operations are permitted under International Law. To protect the security and the interest of medium and small nations, the Government of Brazil strongly urges that a provision be incorporated in the future Treaty on the non-armament of the sea-bed and ocean-floor with a view to effectively enable the Coastal State to participate in control operations that take place on its continental shelf. Such provision must not infringe rights recognized under international law, including the freedom of high seas, nor should they condition the carrying on of control procedures to the previous agreement or good-will of the Coastal State, so long as the control procedures do not involve actions which the Coastal State has the right, under existing positive or customary International Law, or according to the accepted doctrine, to limit or prevent, e.g. access of third States to installations on its continental shelf. In particular such provision should not require previous notification to the Coastal State when only a simple and casual observation in the normal course of navigation or overflight is to take place. However, the Coastal State should be previously notified of the intention of any other Party to implement its right of control by performing a legal but more comprehensive control on the continental shelf of the Coastal State concerned. This would enable the latter to exercise its right of co-participation in the operations thereby protecting its national interests and rights, without any hindrance to the process of control itself.